DOCUMENT RESUME

ED 060 635 EM 009 651

AUTHOR	McDaniel, Lucy V.; And Others
TITLE	Motor Activity Programs Designed for Teaching Supportive Personnel in Physical Therapy. Final Report.
INSTITUTION	Rancho Los Amigos Hospital, Inc., Downey, Calif.
SPONS AGENCY	Social and Rehabilitation Service (DHEW), Washington, D.C.
PUB DATE	Aug 71
NOTE	62p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Health Occupations; *Instructional Programs; Physical Handicaps; *Physical Therapists; Physical Therapy; *Physical Therapy Aides; *Programed Instruction; Rehabilitation; Skill Development

ABSTRACT

A study developed a format for the programed instruction of various physical therapy skills to paramedical personnel. Principles of motor learning and programed instruction served as a guide. An effective first practice and several formats for a second practice evolved. Mandatory second practice with a branching format that allowed students to rehearse difficult sections to correct errors proved most effective. Instructor's guides were prepared, then programs were field tested in hospitals and schools. Field tests showed the programs to meet an error rate criterion of less than ten per cent. Full description of program contents and results is included along with appendices. (RB)

MOTOR ACTIVITY PROGRAMS

Designed for Teaching

Supportive Personnel in Physical Therapy

Final Report

by

Lucy V. McDaniel, Ed. D., R. P. T.
Project Director
Evelyn Britt, Sc. D.
Marijean Piorkowski, B. S., R. P. T.

August 1971

Attending Staff Association of Rancho Los Amigos Hospital, Inc.
12826 Hawthorn Street, Downey, California 90242

This investigation was supported, in part, by Demonstration Grant No. 13-P-55272/9 from the Social and Rehabilitation Service, Department of Health, Education, and Welfare, Washington, D. C. 20201.

SIGNIFICANT FINDINGS FOR REHABILITATION WORKERS

The purposes of this project were: to determine the best program format for the practice of selected motor activities; to develop programmed instructional materials for the activities taught in curriculums for physical therapy aides and assistants; and to evaluate the effectiveness of the programs by field testing.

Findings

Most activities required two programmed practices to reach the criterion of performance of the activity with few or no errors. The most effective first practice directed the student through the activity step by step. Each step consisted of a work and picture description of the step. The most effective second practice was a branching format with reduced cues for each step, self-check questions, and repetition of steps if errors were made.

Twenty-one specific physical therapy activities were developed into instructional programs and field tested. Preliminary results indicate that more than 90 percent of physical therapy aides and assistants will make fewer than ten percent errors. Physical therapy students tended to make fewer errors than did aides and assistants.

Implications

The foregoing results have implications for administrators and instructors of such rehabilitation workers as physical therapists, occupational therapists, nurses, vocational nurses, assistants, and aides. The programs obviously are suitable for teaching any persons who will be performing the activities as a part of their job, whether it be taught in the basic curriculum in a professional school, in a community college, in an inservice training program, or in a refresher course workshop.

The programs also are suitable for those who will instruct rehabilitation workers to perform the activities. Instructors can use these programs as tools to make better use of their professional time. Because the programs are self-teaching, the instructor can spend his time evaluating the performance of the students, and giving special instructions to those who need extra help. The criterion performance of the programs is high, so the result should be personnel highly competent in these skills.

Flexible scheduling will be particularly valuable to the inservice training teacher. Since the programs were written for individuals or pairs, students can take the programs when they are starting a new job or transferring to a different position which requires new skills. When the equipment is limited, individual scheduling may be preferable for large classes also.

ACKNOWLEDGMENTS

We greatly appreciate all who have contributed to the success of this project. We are grateful to the physical therapy supervisors, seniors, staff, and aides at Rancho Los Amigos Hospital who gave expert advice on activity techniques; to the physical therapy departments in all the Los Angeles County Hospitals for their job analysis on which the project was based; and to those in hospitals and colleges throughout the country who helped field test the programs.

We are indebted to our secretaries Celia Williams and Carol Quinones, who typed and retyped our programs ad infinitum.

Greatest appreciation goes to those who took the programs and taught us how to teach motor activities through programmed instruction.

Lucy V. McDaniel, Ed.D., R.P.T.
Project Director

TABLE OF CONTENTS

ABSTRACT

The purpose of this study was to devise a suitable format and to develop and publish motor activity programmed instruction of various physical therapy skills for supportive personnel.

To devise a format for the programs, principles of motor learning and of programmed instruction served as a guide. An effective first practice and several formats for a second practice evolved. Experiments were performed with supportive personnel to determine the best format for the second practice. It was found that a mandatory second practice with a branching format was the more effective way to learn. Students were not good judges of how much practice they needed. They gave better performances if they were allowed to branch through additional practice to correct errors.

The following steps were used to develop the programs: specific behavioral objectives were set, the activity was recorded on video tape for analysis, rough draft with illustrations and checklist evaluation forms were tried on twenty individuals and revised according to errors, and finally, instructor's guides for correct program usage were written.

Programs were then field tested in various hospitals and schools to make sure the programs were teaching effectively. Field test results thus far show that the programs are meeting the error rate criterion of less than ten percent.

CHAPTER I

INTRODUCTION

BACKGROUND INFORMATION

For many years the need for rehabilitation has increased at a greater rate than the ability to provide such services. Physical therapists recognized their responsibility for developing ways of extending their services to disabled persons needing them. In 1967, the American Physical Therapy Association adopted policy statements on the training and utilization of two levels of supportive personnel--the aide and the assistant[1]. The next logical step was to determine the most effective and efficient way to train these persons.

Programmed instruction showed promise in solving many education and learning problems for students and instructors because:

1. Programmed instruction brings students to a standard level of learning.

2. Although learning time varies from student to student, it is less with programmed instruction than with other methods of learning.

3. Minimal teaching time is required once the programmed materials are developed.

Justification for using programmed instruction to train aides in physical therapy has been well documented by McDaniel in Social Rehabilitation Service Grant No. RD-1712-M-66-C1, Final Report[2]. This report goes into the details of refining a two-month curriculum for aides, writing programmed instruction materials for the knowledge aspects of the course and the development of tests to evaluate the effectiveness of the curriculum and the programmed materials. Pertinent to this report was the demonstration that programmed instruction is an effective, efficient, standard method of training aides. The materials programmed and validated were the basic-knowledge subjects:

Bones, Joints, and Muscles of the Human Body

Brain and Nerves of the Human Body

Major Systems of the Human Body

During the programming of the basic-knowledge programs, it became evident that paper-and-pencil programs were not adequate for motor activities, such as assisting a patient to transfer from bed to wheelchair. Exploration of this evidence by our programmers indicated that it would be feasible to program even complex motor activities, but that the programming format needed to be different from that used for basic-knowledge subjects because of fundamental learning differences between basic-knowledge subjects and motor activities. Initial attempts to program activities were burdened with learning the importance of the activity, its purpose, principles, variations, and uses. Correcting the accuracy of performance in the absence of a teacher was a knotty problem.

Few or no authoritative references were available on how physical therapy tasks are done, leaving the task analysis as the method of choice to determine the steps of the activity. Evaluation also needed a different approach. A performance evaluation was indicated to determine if they could do the activity.

STATEMENT OF THE PROBLEM

Purposes

The purposes of this project were: (1) to determine the best program format for the practice of selected motor skills according to the complexity of each; (2) to use this information to develop and refine programmed instructional materials for such skills taught in training curriculums for physical therapy aides and assistants; (3) to evaluate the effectiveness of the materials through field testing procedures; and (4) to produce the programs in book, Tutorfilm, or other appropriate form following validation of their effectiveness as teaching tools.

Theoretical Considerations

To determine the best format for motor activity programs, careful consideration of learning theory as applied to motor skills was needed. Of particular importance was the nature of practice. Should the activity include actual patient treatment, a simulated treatment, or an abstract procedure? Should practice be massed in one time period or distributed over a number of shorter time periods? Should the whole activity be practiced at one time or should parts be practiced separately? Another important theoretical consideration would be the provision of reinforcement. How could knowledge of results be provided during the programmed practice? Could self-evaluation be used? In the past imitation and mental practice were useful in learning motor activities; could these be

successfully programmed? These considerations are covered in a review of the literature.

Practical Considerations

Certain practical considerations were studied before programming of the motor activities was undertaken. The first consideration was the type of activity to be programmed. If activities were those which are frequently rather than rarely used, the programs could replace instructor and classroom time and would be used frequently. Use of the program would allow flexible scheduling since two or more learners could use the program when their work schedules allowed.

Another consideration was the amount of practice needed and therefore how much time would be needed for the students to learn the task. One hour was chosen as a practical time period for two reasons: (1) it allowed the learner enough practice to learn the skill well, and (2) it was the amount of time they could be away from their regular duties. These programs, once developed, could be used on the wards or work areas so that employees would not have to spend time traveling to and from a classroom.

Cost of the programming process was a primary concern in deciding the best way to develop the product. Loose-leaf booklets were chosen because the pages could be removed easily and quickly for revision during development. Filmstrips and movies are very costly during the trial and revision stages. In the future, the booklet form will remain inexpensive for institutions to purchase.

The advantages of these practical considerations are now being appreciated by many of the participants of field testing who used the programs to teach their personnel. Many favorable comments have been made about the convenience of scheduling the learning sessions and the ease of using the booklets.

SETTING

The project was carried out at Rancho Los Amigos Hospital which is a 1050 bed rehabilitation center for chronic disease and disability, operated by the County of Los Angeles to serve a population of seven million. Its primary responsibility is to care for residents of the County with chronic or long-term disabilities who cannot meet the cost of a lengthy period of

hospitalization, and for those who are suffering from some catastrophic disability for which treatment is not available elsewhere in the community.

Patient care units have been classified categorically according to disability and all services work in close cooperation toward realizing the maximum functional potential of the patient and integrating him back into the community. Within each categorical unit all pertinent medical and paramedical specialties are represented on the rehabilitation team. Key members of such a team may include orthopedists, internists, physiatrists, pediatricians, neurologists, urologists, psychologists, vocational counselors, speech therapists, orthotists, nurses, physical therapists, occupational therapists, and social workers.

The major rehabilitation units are comprised of the following categories of disability:

Spinal Cord Inju
Stroke
Rheumatoid Arthritis
Amputation and Problem Fractures
Spine and Hip Deformities
Pediatrics
Neurological Disease
Pulmonary (adult)
Cardiovascular
Admissions and Acute Intensive Care

The Physical Therapy Department is staffed by eighty-four registered physical therapists and forty-eight attendants. The Department reaches its goals of restoring or maintaining maximum patient function through physical therapy rehabilitation treatment techniques, educational programs, and research studies. Nine physical therapy sections were resources for techniques of motor activities. A classroom with physical therapy equipment was used for practice sessions.

The project was carried out by the staff of the Research Section of the Physical Therapy Department. The project director was Research Coordinator, Lucy V. McDaniel, Ed.D. Programmers included the following physical therapists:

Kay Cerny
Marsha Davis
Jean Kristy
Jane D. Lightfoot
Jan Meador

Thelma H. Orr
Marijean Piorkowski
Sheila Rosenblum

Programs were illustrated by Jane D. Lightfoot and Victoria M. White. Evelyn Britt, Sc. D., edited programs. Celia Williams and Carol Quinones performed the mass of secretarial functions.

REVIEW OF RELEVANT LITERATURE

Many books and articles have been written on the programming of instruction materials. Those pertaining to programming in the cognitive area have been reviewed thoroughly by McDaniel. The review presented here concentrates on literature dealing directly with the programming of motor activities and is discussed in two parts:

1. Part 1, which is concerned with principles of motor learning.

2. Part 2, which applies to the programming of motor activities.

Principles of Motor Learning

Although motor learning really cannot be separated from other kinds of learning, it is different because it requires a higher level of motor activity which is observed and measured easily. Aspects of learning of special concern to motor activities deserve special attention, such as:

1. Various ways to practice a skill.

2. Method of reinforcement.

How to Practice a Skill. Learning by doing (practice) is a concept basic to motor learning. However, differences of opinion center around how to practice, such as real vs. simulated situations, whole vs. part practice, mass vs. distributed practice, imitation, and mental practice.

Learning is most efficient when one practices the real thing. Transfer of learning occurs in simulated practice, however, as long as the responses are nearly the same as for those in the real situation[3].

An activity can be practiced using the whole method, the part method, or the progressive part method. In the whole method the student practices the complete task from start to finish in one trial. When the part method is used the student practices one part of the task at a time until he is

completely successful in performing that part. He then proceeds to the next part. In the progressive part method the student practices the first part, then the second. Next, he practices the first and second parts together before learning the third part, and so on[4]. Koch and Bartons concluded that the method of choice depends on how long the learner is able to concentrate on a task, or the length of a learner's memory span, rather than on the complexity of the task itself[4]. They found that the part method sometimes results in quickly reducing errors while the whole method results in more rapid learning of the entire task[5, 6]. Other researchers found the whole method worked better for the more intelligent learner. They also found the part method better for teaching complex skills that require integration of steps, and the whole method better for a single unitary activity[4].

Some authorities favor mass practice; others prefer distributed practice with rest periods[7, 8]. Mass practice is defined as practicing the skills consistently and continuously during one practice period. In distributed practice the skill is practiced during several shorter periods with rest in between each period. According to Pechstein[9], the method of choice is determined by the nature of the task. He concluded that:

1. Massing is best if the problem is short.

2. In connecting the units of a complex skill it is best to break the unit into parts and mass practice those parts.

3. Distributing practice is effective in eliminating unnecessary task components in a complete task.

Experimentally, no difference in retention was found between mass or distributed practice of a skill[10, 11]. Spacing, however, seemed to facilitate learning of motor skills by cutting down on boredom and fatigue which can retard performance[4].

Imitation, or modeling, can enhance motor learning when combined with work instruction[4]. Karlin and Mortimer compared visual cues to verbal cues as they measured motor activity by imitation of a crank-turning task and found that visual cues were superior for task retention[13]. Effectiveness of visual-verbal instruction increases if the learner is allowed to immediately imitate the instruction[12].

Mental practice, in which the student thinks through the task step by step before he actually does the activity is especially good for activities that require strategy and organization[14]. In a study by Jones, results indicated that subjects (male college students) may learn gross body skills

with mental practice[15]. Several investigations have found that thinking through an activity is helpful. "In no case, however, has mental practice, by itself, been demonstrated to be more efficient than physical practice, especially when muscular endurance is required to perform the task."[12]

Method of Reinforcement. Reinforcement is that essential part of the learning model which insures the repetition of the correct response. Success and social approval are examples of stimuli that are often reinforcing. In programmed instruction the knowledge of the correctness of the response is used as a reinforcer. The expected response is often presented after each frame, giving immediate feedback to the student of his success or failure with that frame. A program, with increasing difficulty at each frame but with frames which are usually answered correctly, gives the sutdent a feeling of success and positive reinforcement. "For early approximations of a motor skill, standards must be quite broad so that reinforcement is frequent."[16] As performance improves, standards should be narrowed to produce further improvements.

PROGRAMMED INSTRUCTION APPLIED TO MOTOR ACTIVITIES

Although little has been published about the use of self-instruction for teaching a procedural skill, the value of programmed instruction improving individual performance has been shown.

The University of Washington School of Medicine used a single concept film accompanied by a self-instruction program to teach students in experimental pharmacology[17]. The system was called cinematic self-instruction.

Hinsvark developed two programs using 35 mm. still pictures synchronized with a tape recorder to teach the motor skills of needle threading and gowning and gloving for surgery[18].

Trainex Corporation of Garden Grove, California, developed programs for teaching nursing procedures[19]. Pictures were put on filmstrip synchronized with a recording on which verbal directions were given. This was only a demonstration, however, since it included no active response by the student.

The Technical Training Branch, Training Research Division, Behavioral Science Laboratory in cooperation with the Air Training Command at Lackland Military Training Center, developed and used programmed material to teach a manipulative task (the assembly and disassembly of

the Ml carbine)[20]. Several modes of presentation were evaluated, including audio-visual book, linear program book, and linear program book with answer sheet. No one mode was found superior or inferior to the other modes. The authors said that the "typical lecture-demonstration mode probably cannot be relied upon to give consistent results due to the great variability among instructors and that the greater uniformity of presentation offered by programmed instruction modes can reasonably be expected to produce more consistent levels of performance in the trainee."[20]

Becker and Milhelcic devised programmed instruction to teach intramuscular and subcutaneous injections which used a teaching machine that synchronized a tape-recorded narrative with slides displaying views of the steps at approximately the angle of self-performance[21]. The student could pace the "demonstration" as desired by stopping the machine and/or repeating a step. The program was tested on six non-medical people and modified for teaching student nurses. Although reference was made to practice and reinforcement, the article did not state how these were accomplished.

Taber suggests that "an ideal" program for teaching skilled performance should contain instruction in (1) verbal and non-verbal subject matter knowledge, (2) the training of discrimination between good and poor performance elements in others who are working at the same task, (3) reinforced error detection of self-observation, and (4) further practice of the task in a variety of contexts and with modifications[16].

CHAPTER II

PROGRAM FORMAT

One purpose of this grant was to determine the best format for programming the tasks performed by supportive personnel in physical therapy. This part of the study consisted of two phases, one exploratory, the other experimental. During the exploratory phase, gross questions were answered, an efficient programming procedure was established, and specific questions were raised. During the experimental phase, data were gathered by several simple experiments to answer the more specific questions.

EXPLORATORY PHASE

Three activities were programmed in different formats during the exploratory phase. These activities, varying in complexity, were selected from tasks identified by a job analysis conducted by the physical therapy departments of the Los Angeles County hospitals. The first, Wheelchairs: Maneuvering and Adjusting Parts, is a program of a simple activity in which one student maneuvers the chair, adjusts the footplates, removes the armrests and folds the wheelchair. Pivot Transfer is a program of a moderately complex procedure in which one student assists another student, who plays the role of a stroke patient moving from a bed to wheelchair. Bridging in the Supine Position is a program of a more complex activity in which two students coordinate their efforts to position the third on pillows, relieving sàcral pressure. Activities were classified according to complexity, as described in Appendix A.

To guide development of the programs, some principles of motor learning were applied. The principles were:

1. The student would imitate pictures used as a model.

2. The student would be guided through the activity so that he got a kinesthetic feeling of how it should be done.

3. The student would practice to a point just short of fatigue.

4. The whole method of practice would be used if it did not confuse the student. The part method would be used for parts of long, complex procedures.

5. The students would roleplay the activity in a specified, typical situation that simulated a treatment situation as much as possible.

The programs were developed to achieve goals which include the principles of programmed instruction. The goals were:

1. After completing the program the student would be able to perform the activity with an error rate of less than ten percent.

2. The program would consist of specific chronological steps.

3. Each step would require a pertinent action.

4. Enough information (words and pictures) would be given in each step for the activity to be done correctly most of the time.

5. Prompting would be reduced gradually, requiring the student to recall how to do each step.

6. Some method of self-check would be devised so the student could learn immediately if he was correct.

7. Each student would complete the program at his own speed.

8. A performance evaluation would test the student's ability to do the activity at the level stated in the objective.

9. The program would require a minimum of instructor and student time.

Subjects for program trials were as similar as possible to those for whom the program was intended--supportive medical personnel. They were steno-clerks, physical therapy aide trainees, or nursing aides. They had ten to fourteen years of schooling and were between 18 and 60 years of age. They had no prior experience with the motor activity to be learned.

The process used to develop cognitive programs was modified for motor activities into the following general procedure:

1. Specific behavioral objectives were set.

2. A safe, efficient method of performing an activity was analyzed into the steps and key points required for success; this was done by observing skilled persons perform the activity. This analysis substituted for the detailed outline used in cognitive programs.

3. The first draft of the program was written and illustrated. Illustrations were an essential part of motor activity programs in contrast to being a helpful part of cognitive programs.

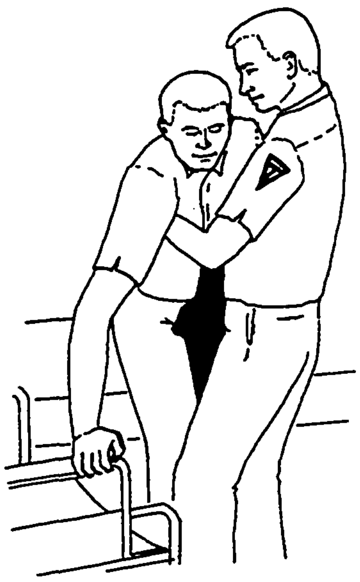
4. The program was tried with individuals and revised after each trial. To determine how to change the program it was necessary to observe the trial as well as to question the subject, since there were no records of performance to be studied. This step was repeated until the goals were met.

5. As gross errors were eliminated, a checklist was compiled from the key points of the activity analysis. This list provided more accurate evaluations of performance to support program revision.

Experience gained during the development of the first motor activity programs showed that learning an activity was feasible by programming the practice of the activity. It was found that a specific example of the activity must be programmed. Brief directions in the imperative mood with appropriate illustrations succeeded in generating action. It was grossly obvious that explanations of why a step was done a certain way was time consuming, was not helpful to learning, and broke up the learning chain of the procedure. Correct repetition of steps done incorrectly in the first practice confused the student and again broke up the learning chain of the procedure. Thus we concluded that the first practice required complete illustrated directions. One step of the activity was presented at a time. The step included a picture and a word description of the action. The amount presented at one time was determined by trial. With brief, concise directions, the first practice guided the student through the skill, giving him a kinesthetic feeling of the whole activity. An example of a series of steps in the first practice is shown in Figures 1, 2, and 3.

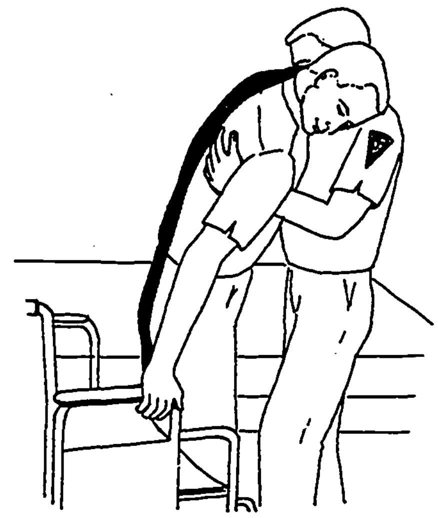
Unanswered was a threefold question crucial to the efficient development of future programs. After the first practice, what format would be most effective in guiding the student through the additional amount of practice required to learn simple and complex activities: one which allowed the student to decide, one with reduced cues as predetermined by study of a sample group, or one with self-check criterion questions that guided further practice?

To answer these questions two programming formats for each of three programs, Wheelchairs, Pivot Transfer, and Bridging, were compared in experiments in the next phase of the study.



Tell the patient to stand up as you pull his trunk forward, lift his hips and push against the patient's knee.

Turn to page 27.



Tell the patient to turn as you help him turn and as you continue to support the strong shoulder and weak hip.

Turn to page 28.

Figure 1
Pivot transfer, first practice. Note step-by-step directions of how to assist the patient to stand.

Figure 2
Pivot transfer, first practice. Step-by-step directions on how to help the patient turn.

Tell the patient to sit down slowly,
as you bend your hips and knees and
pull forward on his shoulder.

Turn to page 29.

Figure 3
Pivot transfer, first practice. Picture and words describe how to safely help the patient sit.

EXPERIMENTAL PHASE

To determine more specifically the best format for the second practice--optional, mandatory, linear, or branching--three hypotheses were tested. Each will be considered in turn.

Hypothesis #1

An optional second practice is as effective as a mandatory second practice.

Methodology

Experimental design. Two groups of subjects took the Wheelchairs program. Because this is a familiar activity, each person took only those parts of the program which he could not do satisfactorily as determined by a pretest. The first practice of the program was the same for both groups. The first group took a program format which required them to decide which parts of the program they would practice a second time, i.e., an optional second practice. The second group took a program format which required all students to take a second practice. During the second practice cues were reduced and self-check questions were asked after each part was completed. If the questions revealed that the student had made errors, the student repeated the part correctly. This format was called a mandatory second practice.

Subjects. Ten supportive medical personnel who had little prior experience with wheelchairs were randomly assigned to the two comparison groups.

Test. The performance of each part of the activity was evaluated by the programmer, an expert in the use of wheelchairs, before and after each subject took the program. The subject was given a quality grade of excellent, good, fair, or poor on each part of the program.

Procedure. Each student was assigned to a group; then given an evaluation of his performance. He took those parts of the program on which he received a fair or lower grade. Immediately after he completed the program his performance was again evaluated. The data were analyzed statistically using chi square to determine the significance of a difference between two groups in frequency of grades on parts of the program.

Results

The results of the comparison of an optional second practice with a mandatory second practice for Wheelchairs are shown on Table 1. The five subjects taking the optional practice took a total of 19 parts and received excellent or good grades on only 7 of those parts. In contrast, the subjects taking the mandatory practice took a total of 20 parts and received excellent or good grades on 17 parts. The fact that the mandatory practice resulted in significantly higher grades than the opticnal practice indicated that the students were not good judges of their own need for further practice. The optional second practice, therefore, was eliminated from further consideration.

TABLE I

COMPARISON OF MANDATORY AND OPTIONAL SECOND PRACTICE OF WHEELCHAIRS: MANEUVERING AND ADJUSTING PARTS

Grades of Ten People on a Total of 39 Parts of Program

	Mandatory Practice	Optional Practice	Total
Grades			
Excellent and Good	17	7	24
Fair and Poor	3	12	15
Total	20	19	39

$\chi^2 = 7.26 \quad p < .01$

Hypothesis #2

A linear second practice is as effective as a branching second practice in learning a moderately complex motor activity.

Methodology

Experimental design. Two groups of subjects took the Pivot Transfer program. The second practice of the program which the first group took was linear in format while the second practice, which the second group took, was branching in format.

In the linear format cues were reduced in the first and last few steps of the second practice. Complete directions were given for the more difficult steps in the middle of the program. The cues needed were determined by trials. Cues were kept if most of the students needed them, or were omitted if most of the students did not need them. Examples are shown in Figures 4 and 5. This was called a linear format because each student did each frame of the program in the same order without repeating any part of the activity separately.

HELP THE PATIENT STAND.

Tell him to stand.

At the same time, lift his hips, push against his knee and pull his trunk forward.

Fig. 4. Linear format of second practice. All cues are given that the student needs.

HELP THE PATIENT TURN AND SIT SLOWLY.

Fig. 5. Linear format of second practice.

The branching format of the second practice presented a picture and name of each step. After each step the student was provided with questions so designed that he knew if he made an error. What he did next depended on his response to the questions. He took one of the following branches. With each omission, he was directed to complete the step. With each error, he was required to repeat the step. Examples of this format are shown in Figures 6, 7, and 8.

Subjects. Twenty nursing aide and physical therapy aide trainees with no prior knowledge of the activity were randomly assigned to the two groups.

Tests. Checklist scores, quality grade, and time on an activity performance were the tests used. Time was the minutes required for the performance. Quality grades were judgments of an expert expressed in terms of excellent, good, fair, or poor. The checklist score was percentage of items missed.

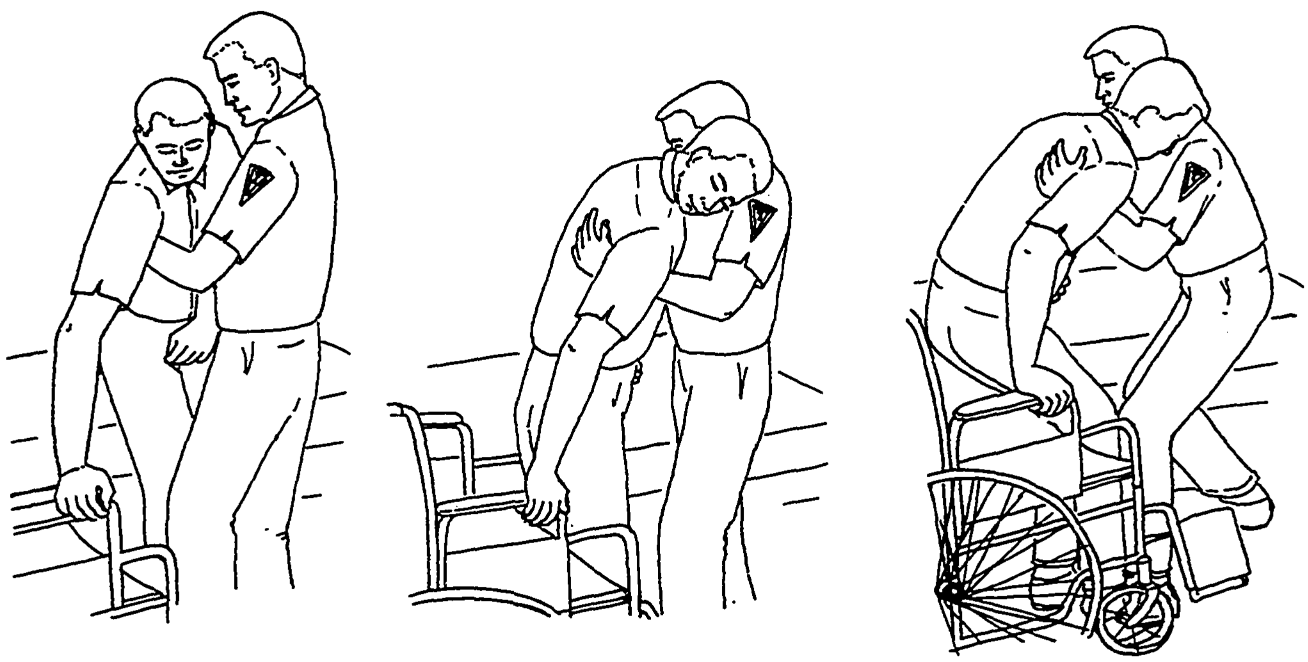
The validity of the checklist was based on its development along with the program. The list consisted of items made up of the key points from the activity analysis. These items were stated in concrete, specific terms and were rated as done or not done. Each time the program was tried, the checklist was tried. If key points were changed, items were changed accordingly. Particular effort was made to eliminate words requiring judgment and words with several meanings.

The reliability of the checklist was documented by having a group of physical therapists rate the performance of individuals doing the activity and by calculating the percentage of agreement on items among observers. Fifteen supervising physical therapists prepared to evaluate the performance of the activity by reading the program, observing someone else take the program, and by studying the evaluation form. The group met and observed the individuals perform the activities. The observers filled out the checklist and totaled the errors.

The percentage of agreement was calculated by determining for each item the percent of the observers who agreed that the item was done correctly or was missed. For example, an item on which 60 percent said it was correct and 40 percent said it was missed, had 60 percent agreement. An item in which 60 percent said it was missed and 40 percent said it was correct also had 60 percent agreement. A 50-50 percent item had the lowest possible agreement. A 90-10 percent item had high agreement. The percentage of agreement for the checklist was the mean of the values for the items. It was 92 percent.

ASSIST THE PATIENT TO TRANSFER.

Figure 4.
Branching format of second practice. Picture and step name given only.



Did you tell the patient to stand, turn and slowly sit?

As he stood up, did you pull his trunk forward and lift his hips? Brace his knee with your knee?

As he turned, did you help him turn?

As he sat down, did you bend your hips and knees and help him sit slowly?

Yes - Turn to page 57.

No - Turn to page 56.

I can't remember - Turn to page 56.

Figure 5.
Branching format of second practice. Student checks his work to see if he did the step correctly.

Have the patient sit on the bed, grasping the far armrest. Brace his good foot and knee, place one hand under his weak hip, the other under his strong arm.

Now tell the patient to stand up as you pull his trunk forward, lift his hips and push against the patient's knee.

Tell the patient to turn as you help him turn and as you continue to support the strong shoulder and weak hip.

Tell the patient to sit down slowly, as you bend your hips and knees and pull forward on the shoulder.

Turn to page 57.

Figure 6.
Branching format of second practice. If the student made a mistake according to the prior page, he repeats the step correctly as described here.

Procedure. Pairs of subjects were randomly assigned to one of the two groups. They took the program and their performance was evaluated when they finished it. Performance time was recorded, over-all quality was judged and recorded, and error rate was calculated for each subject. Statistical analysis included computing the "t" score to determine the significance of differences between the group mean time and error rate. The Fischer test was used to determine the significance of differences in quality grades.

Results

The results are shown in Table 2. There was no statistically significant difference between these two groups in error rate or on the time required to do the transfer. However, the group which took the branching format received more over-all grades of excellent and good, and fewer over-all grades of fair and poor than the group that took the linear format.

TABLE 2

COMPARISON OF LINEAR AND BRANCHING FORMATS OF PIVOT TRANSFER

	Branching	Linear	Test of Significance	Significance
Number of Subjects	10	10		
Error Rate (%)				
Mean	4.8	7.4	t = 1.24	None
Standard Deviation	1.58	1.86		
Performance Time (Mean number of minutes)	2.4	2.3	--	None
Grades (Number of subjects)				
Excellent and Good	9	3		
Fair and Poor	1	7	Fisher	p = .01

Hypothesis #3

A linear format is as effective as a branching format for the second practice of a complex motor activity. This hypothesis differs from #2 only in the complexity of the activity.

Methodology

Experimental design. The program, Bridging in the Supine Position, was chosen as an example of a complex activity. Again two groups of subjects took alternate forms of the program, one using a linear second practice, the other using a branching second practice.

Subjects. Twenty nursing home aides were randomly assigned to the two groups.

Tests. Checklist scores and quality grades were the tests used. Validity of the checklist was developed as it was for Pivot Transfer. Reliability was checked by having sixteen supervising physical therapists rate the performance of subjects doing the activity and then calculating the percentage of agreement. This was 95 percent.

Procedure. The procedure used for Pivot Transfer was repeated.

Results

The results of the comparison of linear and branching formats by Bridging in a Supine Position are shown on Table 3. In this case the error rate for the branching format was significantly lower than that for the linear format.

TABLE 3

COMPARISON OF LINEAR AND BRANCHING FORMATS
OF BRIDGING IN A SUPINE POSITION

	Linear	Branching	Test of Significance	Level of Significance
Error Rate (%) (Mean)	15.2	11.8	t = 2.56	p = .02
Grades (No. of subjects)				
Excellent and Good	5	6		
Fair and Poor	5	4	Fisher	None

Discussion

The idea that the student is capable of determining how much practice he needs was not supported by our study. The reason may be that he did not know the criterion performance and so could not evaluate himself. The idea of teaching the student this discrimination could be investigated further. However, the optional second practice was not an efficient format for teaching the activity in minimal time.

The branching format for the second practice proved to be the most effective for programs of different levels of complexity. The second practice of the activity required the student to remember mentally and kinesthetically how to do the activity with minimal visual cues. The questions reviewed all the key points of the steps and so provided both feedback on the correctness of the student's practice and mental practice of the step.

During trials, it was noticed that the students using the linear format who made errors during the first practice continued to make the same errors in the second practice. With the branching format, students frequently corrected their errors when they read the self-check questions in the second practice and did not repeat their errors.

The results of the comparative studies with the two formats led to the choice of the branching format for the mandatory second practice.

Summary

The exploratory phase of determining the best format was guided by principles of motor learning and goals based on principles of programmed instruction. Findings were that a specific example of the activity should be selected and that the first practice should have concise, illustrated, step-by-step directions in the imperative mood as shown in Figures 1, 2, and 3.

Three formats for a second practice were compared in the experimental phase. An optional practice was not as effective as a mandatory branching second practice for a simple activity. A linear format was not as effective as a branching format for either a moderately complex or a complex activity. A branching format was chosen for the second practice for the development of motor activity programs. The student moved to the next step if he was correct, completed the step if he omitted a part, or repeated the step correctly if he made an error as shown in Figures 6, 7, and 8.

An efficient method of developing programs was also established and described in detail in Chapter III.

CHAPTER III

PROGRAM DEVELOPMENT AND FIELD TESTING

PURPOSE

The purpose of this part of the project was to develop and field test motor activity programs to train physical therapy aides in tasks needed for patient care.

DEVELOPMENT

The first step in the development for each motor activity program was to state the objective for the program in behavioral terms. Using Pivot Transfer as an example, the objective was to be able to transfer a stroke patient safely from the bed to the wheelchair using good body mechanics and having the patient help himself as much as possible. Criteria was successful completion of the transfer without cues with few or no errors in three to five minutes.

The second step was to record on video tape an expert doing the pivot transfer. Video tape was selected because it provided a permanent record of the transfer which the programmer could view repeatedly. Therefore, the expert only had to perform the transfer once for the video tape session and then could return to his regular duties.

The third step was to write a task analysis from the video tape. Major steps of the activity, with the corresponding key point describing how to perform the steps, were written. This task analysis was reviewed by physical therapists who were experts in the technique. Next, an inexperienced physical therapy aide performed the skill as the task analysis was read to him. Wording revisions then were made as needed.

The fourth step was to illustrate each key point and to write a rough draft of the program. Another inexperienced physical therapy aide took the program as the writer observed his performance. Errors, hesitations, and questions by the aide were noted as he worked through the program. After one practice with specific directions, and a second practice with reduced directions and self-check questions, the aide performed the skill for a third time without the booklet. As he did, the writer evaluated his performance on a checklist evaluation form taken from the key points of the activity. A sample evaluation may be seen in Appendix B. The writer then revised the program according to the mistakes or hesitations made

by the student and his comments and criticisms. The evaluation form was revised as changes in the program were made. Step four was repeated about ten times until the student was able to work through the program without hesitation and with few errors. Next, another ten individuals tried the program to see if some key points were consistently missed. Revisions then were made on these key points.

Creating an instructor's guide was the last step in program development. The purpose of the guide was to tell the instructor how to prepare for, give, and evaluate the program. The guide also included for each program the objective of the program, equipment, space, and personnel needed. A sample instructor's guide is shown in Appendix C.

DESCRIPTIONS OF PROGRAMS

The programs were written to teach activities in four areas of physical therapy treatment techniques. A breakdown may be seen in Table 4, and a description of the content of each program is given in Appendix D. Most programs take one hour to complete. Usually the programs require two students; one practices the activity while the other plays the role of the patient. After two practices the students switch roles. When both students have completed two practices, they report to their instructor for evaluation. At this time each student performs the activity again without referring to the booklet.

FIELD TESTING OF MOTOR ACTIVITY PROGRAMS

The purpose of the field testing was to determine if the programs taught the activity correctly. Three levels of personnel took the programs: physical therapy aides who were generally trainees on the job, student physical therapy assistants who were completing a two-year college course, and student physical therapists who were completing third, fourth or fifth year of college to become professional physical therapists.

The supportive personnel target group for field testing was composed of aides and student physical therapy assistants. In addition, student physical therapists also were tested to determine if the programs would be effective learning tools for this group with higher educational levels.

The programs that are noted by asterisks in Table 4 were sent to various hospitals and colleges across the United States. A list of these institutions is shown in Appendix E. Each local institution participating in field testing was visited by a programmer from the investigator's staff. The

TABLE 4

A. APPLIED BODY MECHANICS

* Wheelchairs: Maneuvering and Adjusting Parts
* Mechanical Lift Transfer
* Pivot Transfer
* Push-Up Transfer with Sliding Board
Swivel Bar Transfer

B. POSITIONING

* Bridging in the Supine Position
* How to Assist a Hemiplegic Patient into a Prone-Lying Position
* Tilt Table: Positioning and Standing the Patient

C. AMBULATION ACTIVITIES

* How to adjust Canes and Crutches
* How to do Various Crutch Gaits
* How to Assist a Stroke Patient to Walk with a Quad Cane
Assisted Gait with Walker
Spinal Cord Injury Assisted Gait

D. EXERCISE EQUIPMENT AND BASIC ROUTINES

* Range of Motion Exercises
How to Use the Skateboard
How to Use Slings and Springs
How to Use the Rickshaw
How to Use the N-K Table
Overhead Pull with Downward Thrust Using the Exercise Board
Hip Abduction from a Guerney Using the Exercise Board
Hip Extension from the Standing Bars Using the Exercise Board
Hip Abduction with Extension Using the Elgin Table
Mass Flexion Using the Elgin Table
Mass Extension Using the Elgin Table

* Programs presently being field tested.

purpose of the visit was to make sure that the program was given in the correct manner. The programmer explained to the instructor what equipment was needed, how the students should use the program, and how to evaluate the students. The programmer then gave the students the first program to check that they used the program correctly. For the evaluation, the instructor and programmer both evaluated the students. Next, they compared their evaluations and discussed difficulties or differences.

Since it was not feasible to use this procedure for field trials outside of the Los Angeles area, the investigator wrote to the distant facilities and stressed the importance of instructors carefully following the procedure described in the instructor's guide for reliable results.

To measure the effectiveness of learning from the program, it was decided that each program should have an error rate of less than ten percent on the checklist evaluation which was determined by dividing the mean errors by the total possible errors for that program. The error rates for all programs are listed in Table 5. Perusal of this table shows that all of the programs are well within the error rate criterion. Programs would be made ready for publication if 50 field trials proved that they met the ten percent error rate criterion. Wheelchairs and Pivot Transfer have met this criterion. Tilt Table, Push-Up Transfer, Various Crutch Gaits, Range of Motion, Bridging in the Supine Position, and Prone-Lying still need additional subjects. However, the low error rate looks very favorable for success.

As mentioned before, the programs also were given to physical therapy students in several schools. These programs were well received by both instructors and students, with comments that the activity was learned to a high level of skill and that the students felt confident in their ability to perform the activity.

When physical therapy students were compared with the aides and student assistants on mean errors and error rate, student physical therapists were consistently better, except when they learned how to walk on crutches for the Various Crutch Gaits program. This discrepancy perhaps could be explained by the fact that aides frequently saw patients walking on crutches in the hospital but students who had no hospital experience had difficulty simulating crutch walking (see Table 6).

Additional examination of the mean errors of the three groups of learners did not always show the groups as statistically different entities (Table 7). Analysis of variance for Wheelchairs: Maneuvering and Adjusting Parts, and Pivot Transfer reflected a difference among all three groups. When aides and assistants were combined, then compared to physical therapy

TABLE 5

MEAN ERRORS AND ERROR RATE OF PROGRAMS FOR AIDES AND ASSISTANTS

Program	Number of Subjects	Mean Errors	Standard Deviation	Total Errors Possible	Mean Error Rate
Wheelchairs: Maneuvering and Adjusting Parts	63	2.05	4.08	24	.08
Pivot Transfer	67	3.22	1.62	48	.07
Push-Up Transfer with Sliding Board	43	2.23	5.90	38	.06
How to Assist a Hemiplegic Patient into a Prone-Lying Position	22	2.68	2.15	41	.06
Tilt Table: Positioning and Standing the Patient	19	1.42	1.31	40	.04
Range of Motion Exercises	44	8.06	5.10	134	.06
How to do Various Crutch Gaits	19	1.0	.56	30	.03
Bridging in the Supine Position					
Person 1	29	1.48	2.46	23	.06
Person 2	23	.87	1.33	20	.04

TABLE 6

COMPARISON OF MEAN ERRORS AND ERROR RATES OF PHYSICAL THERAPY STUDENTS WITH ASSISTANTS AND AIDES

Program	Mean Error	Error Rate	t	Level of Significance
Wheelchairs: Maneuvering and Adjusting Parts			2.84	< .01
Physical Therapy Student	.54	.02		
Assistant and Aide	2.05	.08		
Pivot Transfer			2.89	< .01
Physical Therapy Student	2.23	.05		
Assistant and Aide	3.22	.07		
Various Crutch Gaits			2.18	< .05 > .01
Physical Therapy Student	1.72	.06		
Assistant and Aide	1.00	.03		
Bridging in the Supine Position			1.92	None
Person 1				
Physical Therapy Student	.56	.02		
Assistant and Aide	1.48	.06		
Bridging in the Supine Position			1.61	None
Person 2				
Physical Therapy Student	.37	.02		
Assistant and Aide	.87	.04		

TABLE 7

MEAN ERRORS OF PROGRAMS ACCORDING TO EDUCATION LEVEL OF PERSONNEL

Program	P. T. Student	P. T. Assistant	Aide	Test of Significance	Level of Significance
Wheelchairs: Maneuvering and Adjusting Parts	0.45	1.11	2.45	$F = 7.15$	$p < .01$
Pivot Transfer	1.66	1.75	2.57	$F = 25.48$	$p < .01$
Push-Up Transfer with Sliding Board	--	2.22	2.25	$t = 0.04$	None
How to Assist a Hemiplegic Patient into a Prone-Lying Position	--	1.88	3.50	$t = 1.07$	None
Range of Motion Exercises	--	6.61	10.86	$t = 3.07$	$p < .01$
		Assistant and Aide Combined			
How to do Various Crutch Gaits	1.72	1.00		$t = 2.18$	$p < .05 > .01$
Bridging in the Supine Position					
Person 1	0.56	1.48		$t = 1.92$	None
Person 2	0.37	0.87		$t = 1.61$	

students, such as was done for Various Crutch Gaits and Bridging in the Supine Position, results for one program showed a significant difference compared with assistants, as in Range of Motion Exercises, Prone-Lying Position, and Push-Up Transfer, results showed that the mean error for the two levels was significantly different for two programs and not significant for a third program. At present these results are inconclusive. Further data should indicate if significant differences exist between the educational levels.

The checklist evaluation form has inherent validity as aforementioned; however, during field testing one further validity check was studied. It was felt that the subjective rating of the over-all performance (excellent, good, fair, poor) should be associated with the number of errors made by the students. If the two factors were adequately associated one could expect omega squared to be .50 or more. One can see from Table 8 that only Pivot Transfer and Various Crutch Gaits approached this level. Again, however, a small number of subjects influence this statistic, as may be seen in Bridging in the Supine Position, Range of Motion, Tilt Table, Prone-Lying, Push-Up Transfer, and Wheelchairs: Maneuvering and Adjusting Parts. Further numbers should show an increased relationship between these two factors.

Future plans include preparation of Wheelchairs: Maneuvering and Adjusting Parts and Pivot Transfer for publication. Field testing will continue on all other programs until sufficient numbers warrant their publication. Finally, some of the programs will be put on filmstrip for use on the teaching machine.

FIELD TESTING OF SELECTED DISABILITY PROGRAMS

Validation of the basic-knowledge programs started in Project RD-1712-M-66-C1 required that field test results meet the criteria for a gain in knowledge of at least 20 percent between pre-test and post-test and an error rate of less than 10 percent.

The subjects, Selected Orthopedic Disabilities and Selected Medical Disabilities (started in Project RD-1712-M-66-C1), have been field tested. Tables 9 and 10 show the age and schooling characteristics of the subjects used for field testing, the mean pre-test and post-test percentage scores, and their standard deviations. Also shown are the mean error rates and their standard deviations. As can be seen, these two programs met the criteria for program validation, namely a gain between pre-test and post-test of at least 20 percent and an error rate of less than 10 percent.

TABLE 8

MEAN ERRORS OF PROGRAMS FOR QUALITY OF EACH GRADE

Program	Excellent	Good	Fair	F	Level of Significance	Omega Squared
Wheelchairs: Maneuvering and Adjusting Parts (Aides and Assistants)	.73	2.38	--	19.23	$p < .01$	.25
Pivot Transfer (Aides and Assistants)	.88	3.29	--	40.45	$p < .01$	.47
Pivot Transfer (Physical Therapy Students)	1.43	5.33	--	20.81	$p < .01$	.66
Push-Up Transfer with Sliding Board (Aides and Assistants)	1.55	2.16	--	1.13	None	--
How to Assist a Hemiplegic Patient into a Prone-Lying Position (Aides and Assistants)	1.00	3.00	--	9.60	$p < .01$	.32
Tilt Table: Position and Standing the Patient (Aides and Assistants)	.57	1.70	--	4.43	None	--
Range of Motion Exercises (Aides and Assistants)	2.83	6.50	15.40	22.81	$p < .01$	.42
How to do Various Crutch Gaits (Aides and Assistants)	.70	1.00	2.50	9.61	$p < .01$	.47
How to do Various Crutch Gaits (Physical Therapy Students)	.18	2.33	4.43	84.60	$p < .01$	.82
Bridging in the Supine Position (Aides and Assistants) Person 1	.94	2.33	--	4.70	$p < .05 > .01$	.14
Person 2	.40	1.60	--	4.26	None	--

TABLE 9

FIELD TEST RESULTS

Selected Orthopedic Disabilities

	Mean	Standard Deviation
N = 137*		
Age (years)	23.20	7.13
Schooling (years)	13.01	1.71
N = 138		
Pre-test	50. %	9. %
Post-test	75. %	15. %
Gain	25. %**	
Error Rate	2.88%**	2.97%

* Age and schooling information lacking on one subject.
** Meet criteria for program validation, i.e.:
Gain of at least 20%.
Error rate of less than 10%.

TABLE 10

FIELD TEST RESULTS

Selected Medical Disabilities

N = 60	Mean	Standard Deviation
Age (years)	28.20	10.70
Schooling (years)	12.17	0.86
Pre-test	46. %	12. %
Post-test	77. %	15. %
Gain	31. %*	
Error Rate	2.87%*	2.74%

* Meet criteria for program validation, i.e.:
Gain of at least 20%.
Error rate of less than 10%.

Final editing has been completed on both programs, Selected Orthopedic Disabilities and Selected Medical Disabilities, and both have projected publication dates of 1972. In addition, the program Selected Neurological Disabilities, which requires approximately 13 to 14 reading hours, is in the process of being revised and readied for further field testing.

Brief synopses of units covered in the Selected Orthopedic Disabilities and Selected Medical Disabilities programs can be found in Appendix F.

CHAPTER IV

RECOMMENDATIONS FOR UTILIZATION AND FOR FURTHER STUDY

The recommendations for utilization of the results of this project to be presented in this chapter are:

1. Who might use the programs.

2. How the programs can be used effectively.

3. Recommendations for further study.

WHO SHOULD USE THE PROGRAMS

The end products of this project are programmed booklets that teach frequently-used physical therapy motor skills. The target population was supportive personnel in physical therapy. Development of content has been directed by the curriculum requirements of this group and their special needs, then tried, revised, and field tested on the same type population.

Since the skills that have been programmed are basic to patient care, the programs have a wider application than training of target personnel. Nurses and occupational therapists frequently perform the same skills and thus could benefit from usage of the programs.

Several schools of allied health professions participated in field testing. It was apparent from their commendatory letters that the programs were successful for training the students of health professions.

Programs could also be used as teaching tools for rehabilitation workshops. Previously-trained professionals could broaden their knowledge of rehabilitation skills for disabled patients.

Usage of the program to train families of disabled members is an idea that needs further exploration. The programs would need some revision since this is a group of learners without a background in medical education. However, the need for training this group merits investigation of the use of programs.

The programs are not usually beneficial for training personnel who do the skill in a different way. This group of learners have difficulty changing

old habits for new ones. This is not a problem for learners who are unfamiliar with the skill.

HOW THE PROGRAMS CAN BE USED EFFECTIVELY

Although these programs are designed as self-teaching units, this does not imply that they stand alone. The student must first be informed of how to use the program. This should include an explanation of why the skill is important to his job training. This explanation will encourage the student to concentrate on learning the skill. The teacher will also need to check the level of learning before allowing the student to apply his new skill to patient care. This time can also be used to plan follow-up work according to the student's level of skill. For example, it may be apparent from evaluation that he needs further guidance in the "simulated situation," or that he may now be ready to work with patients under the teacher's guidance.

Three possible ways that the teacher could use the programs as teaching tools are presented. The usage would depend on his presentation to the student. First, he might present them in a highly-structured environment in which the student would learn the activity as the only way to perform the skill. While this might give the learner specific direction, it reduces the possibility to think creatively. If the student learns best this way, or if his job requires him to act only in one manner, then this might be the teaching method of choice. The second method of presentation is that the student would learn the activity as one way to do the skill. The teacher would then assist the student to generalize his knowledge so that he could adapt the skill to fit the varying abilities of different patients. The third manner that the teacher could use the program is in a self-learning laboratory. This idea was shared with us by Jo Ann Tomberlin, who is an instructor at the School of Allied Health Sciences, University of Texas, and is involved in training of professional physical therapists. Her objectives for the students were to begin self-evaluation, start accepting the responsibilities of independent study, and develop beginning skill in critical analysis. Her plan follows:

"1. The programs are available in the classroom for the students at all times.

2. The special equipment needed by each program is also available in the classroom.

3. The objectives of the programs have been discussed with the students.

4. Each student has five weeks to complete all ten programs.

5. A master board is provided to mark the date completed and evaluated.

6. The students share the responsibility of completing the evaluation sheets; that is, the students are evaluating each other.

7. The final evaluation will be done by me in the latter part of the fall trimester."[22]

RECOMMENDATIONS FOR FURTHER STUDY

Individual differences in perception became quite apparent during trials and warrant further study. Some subjects read the words only; some looked at the pictures only; some did both. Interpretations of meaning varied enough to make one hypothesize that subjects varied in perceptual style. If styles could be identified, it would be worth investigating what program format would be most effective for each style.

Also worthy of study is the use of self-evaluation in programs to reinforce closer and closer approximations of the criterion motor behavior. Self-evaluation requires discrimination between correct and incorrect performances. Therefore, the role of teaching a student to discriminate is relevant. Should it be taught as the first step of motor activity as Taber[16] suggests, or should finer and finer discriminations be taught as skill develops? These questions deserve further investigation, especially for motor activities requiring a high level of skill. Pertinent to the procedural activities of the programs developed in this project is the question, which judgments require fine discrimination and which require gross discrimination?

As little programming of motor activities has been done, further exploration and experimentation are indicated.

CHAPTER V

SUMMARY

As the need for medical services increased faster than the training of professional personnel, it became rapidly apparent that utilization of sub-professional personnel could help meet the need for services. The next step was to initiate effective training for these people. Programmed Instruction had been proved as an effective tool for teaching a basic-knowledge curriculum. Certainly it must be effective for teaching those motor activities that supportive personnel must be skilled in performing. To date, close scrutiny of the literature shows very little to guide the choice of program format or to use as a model of development. The purpose of this project, then, was to seek the most effective format for learning, to develop programs for physical therapy skills, to evaluate their effectiveness by field test procedures, and to produce validated programs in book and tutorfilm media.

Discovering a suitable format was the first phase of fulfilling the purpose of this grant. Three skills of varying complexity were studied for programming: Wheelchairs: Maneuvering and Adjusting Parts was a simple activity, while Pivot Transfer was moderate in difficulty, and Bridging in the Supine Position was the most complex in difficulty of the three. A combination of principles of motor learning and principles of programmed instruction guided the exploratory process. The resulting format of the first practice was illustrated sequential steps of the activity with concise directions in the imperative mood.

Certain questions remained to be answered to determine the best format for the second practice. First, would an optional second practice, which allowed the student to choose if he needed further practice, be as effective as a mandatory second practice which all students would take? Results of a comparative experiment showed that students who took the mandatory second practice performed significantly better on evaluation than those students who had the optional second practice. Results indicated that the students were not good judges of their own need for further practice. The mandatory second practice was included in the program format.

Second, was a branching format as effective as a linear format for the second practice? The branching format included a prompting frame which gave the student the step name and the picture of the action he should perform next. After performing the step with these cues, he turned the page and read self-check questions. If he performed the step correctly according to his replies to the self-check questions, then he took the branch to continue to the next step. If he found that he had made a mistake, then he

took the branch to repeat the step correctly. The linear format differed in that the student did not repeat the step if he made a mistake. Results from an experiment comparing branching to the linear format showed that branching was a more effective way to present the second practice. This result was measured by use of a checklist evaluation form. Reliability of this checklist was calculated after sixteen expert physical therapists used the form to evaluate the performance of a student who had completed the program. Therefore, the branching format was retained as the method of choice for the second practice. It was further found that the branching format was effective for programs of varying complexity.

Once the format had been established, the next phase was to develop the programs. The following procedure was used to develop the programs: objectives were stated in behavioral terms, video-tape recordings were made of experts performing the skills, task analyses of steps and key points were written, rough drafts of the programs with illustrations were compiled along with evaluation forms, approximately twenty trials of students taking programs were given, and finally instructors' guides were developed.

To test the effectiveness of the programs as teaching tools, the programs were sent to various institutions in the United States for field testing. The criterion for effective teaching to be met was an error rate of less than ten percent. Although the field testing is not completed, the data so far are meeting the criterion of less than ten percent error rate.

Recommendations for utilization were discussed regarding who might use the programs, how they might be used effectively, and what further study might be indicated. The programs were found to be effective for training supportive personnel and students of allied health professions. Also the programs could be effective for workshops in rehabilitation and for teaching family members of disabled persons. The program's effectiveness as a teaching tool depends on the teacher's presentation of the material. Several methods of presentation were discussed. Three questions were presented for further study. First, if students learn material according to their perceptual style, could program formats be designed to teach that style? Second, how can discrimination between correct and incorrect behavior be taught for self-evaluation? Finally, where in the program should the discrimination be taught? Since little programming of motor activities has been done, further exploration and experimentation are indicated.

Future plans include preparation of the field tested programs for publication in tutorfilm and booklet forms. Selected Neurological, Medical, and Orthopedic Disabilities, which are cognitive programs, will also be made ready for publication.

REFERENCES

1. American Physical Therapy Association. Policy Statements on Training and Utilization of Physical Therapy Aides and Assistants. Phys. Ther., 50: 69-71, 1970.

2. McDaniel, L. V.: Programmed Instruction for Aides in Physical Therapy. Final Report, S.R.S. Grant RD-1712-M-66-Cl, Attending Staff Association of the Rancho Los Amigos Hospital, Downey, California, 1968.

3. Hammerton, M.: Transfer of Training from a Simulated to a Real Control Situation. J. Exp. Psychol., 66: 450-453, 1963.

4. Cratty, B. J.: Movement Behavior and Motor Learning, 2nd Edition. Philadelphia: Lea and Febiger, pp. 271-282, 1967.

5. Koch, H. L.: The Influence of Mechanical Guidance upon Maze Learning. Psychol. Monogr., 147, 1923.

6. Barton, J. W.: Smaller versus Larger Units in Learning the Maze. J. Exp. Psychol., 4: 418-429, 1921.

7. Lewis, D. and Lowe, W.: Retention of Skill on the SAM Complex Coordinator. Proc. Iowa Acad. Sci., 63: 591-599, 1959.

8. Jahnke, J. C. and Duncan, C. P.: Reminiscence and Forgetting in Motor Learning after Extended Rest Intervals. J. Exp. Psychol., 52: 273-282, 1956.

9. Pechstein, L. A.: Massed vs. Distributed Effort in Learning. J. Educ. Psychol., 12: 92-97, 1921.

10. Rubin-Rabson, G.: Studies in the Psychology of Memorizing Piano Music: II-A Comparison of Massed and Distributed Practice. J. Educ. Psychol., 31: 270-284, 1940.

11. Rubin-Rabson, G.: Studies in the Psychology of Memorizing Piano Music: VII-A Comparison of Massed and Distributed Practice. J. Educ. Psychol., 32: 688-696, 1941.

12. Cratty, B. J.: Movement Behavior and Motor Learning. Philadelphia: Lea and Febiger, p. 55, 1964.

13. Karlin, L. and Mortimer, R. G.: Effects of Visual and Verbal Cues on Learning a Motor Skill. J. Exp. Psychol., 64: 608-614, 1962.

14. Richardson, A.: Has Mental Practice any Relevance to Physiotherapy? Physiotherapy, 50: 148-151, May 1964.

15. Jones, J. G.: Motor Learning without Demonstration of Physical Practice under Two Conditions of Mental Practice. Res. Quart., 36(3), 1965.

16. Taber, J. I.; Glaser, R.; and Schaefer, H.: Learning and Programmed Instruction. Reading, Mass.: Addison-Wesley, pp. 22-28, 47-49, 1965.

17. West, T. and Stickley, W.: Cinematic Self-Instruction in Laboratory Pharmacology. In Programmed Instruction in Medical Education. The Rochester Clearinghouse, University of Rochester, pp. 16-124, 1965.

18. Hinsvark, I. G.: Implementing Programmed Instruction in the Operating Room. In Programmed Instruction and the Hospital. Hospital Research and Educational Trust, Chicago, pp. 101-103, 1967.

19. Trainex Corporation: Personal communication, Garden Grove, California, 1967.

20. Folley, J. D. Jr.; Bouck, A. J.; and Foley, J. P. Jr.: A Field Experimental Study of Programmed Instruction on a Manipulative Task. Project No. 1710, Training, Personnel, and Psychological Stress Aspects of Bioastronautics. Task No. 171004, Techniques for Training, aiding, and Evaluating the Performance of Technical Tasks. U. S. Air Force Technical Report, pp. 424-445, 1963.

21. Becker, M. E. and Mihelcic, M. R.: Programming a Motor Skill. J. Nurs. Educ., 5: 25-30, 1966.

22. Tomberlin, Jo Ann: Personal communication, July 15, 1971.

LIST OF APPENDICES

A. CLASSIFICATION OF MOTOR ACTIVITIES

B. EVALUATION FORM

C. INSTRUCTOR'S GUIDE

D. DESCRIPTION OF MOTOR ACTIVITY PROGRAMS

E. LIST OF INSTITUTIONS PARTICIPATING IN FIELD TESTING

F. DESCRIPTION OF SELECTED DISABILITY PROGRAMS

APPENDIX A

BASIS FOR CLASSIFICATION OF MOTOR ACTIVITIES

Features that distinguish between simple and complex motor activities:

	Simple	Complex
1.	Has familiar aspects	New aspects
2.	Can be done slowly	Fast
3.	Requires little force	Much force
4.	Requires little accuracy	Much accuracy
5.	Requires few movements	Many movements
6.	Requires few body parts	Many body parts
7.	Requires simple equipment	Complex equipment
8.	Requires one person only	Two or more persons
9.	Has predetermined procedure	Activity depends on changing situation

Definitions of classes of activity:

1. Simple: Most features are simple.
2. Moderately complex: Some features are simple and some are complex.
3. Complex: Most features are complex.

CLASSIFICATION OF SOME MOTOR ACTIVITIES IN PHYSICAL THERAPY

Simple	Moderately Complex	Complex
Applied Body Mechanics		
Wheelchair Operation	Pivot Transfer	Lift with patient in sitting position
Guerney Operation	Pushing Transfer	Lift with patient in supine position
Equipment Care		Swivel Bar Transfer
Preparation of Patient		
Night Splint	Standing Board	Supine position
Elastic Stocking	Overhead slings	Side-lying position
	Hand Splints	Prone position
	Ace bandage	Body jacket
	Braces	Corset
		Binder
Ambulation		
Adjusting equipment	Doing basic gaits	Assisting basic gaits
Exercise and Basic Routine		
Overhead pulleys	ROM	Exercise board with pulleys
Barbells, Dumbbells	Slings and Springs	Elgin Table
Rickshaw	N-K Table	
	Skateboard	

APPENDIX B

PIVOT TRANSFER EVALUATION FORM

Name: ________ ______________________ Age: ______ Date: __________

Yrs. of Schooling: ______ Previous Hospital Experience (yrs.): __________

Previous Job Title: ______________________________

A. Performance: Check points omitted or not performed as described in program.

1. EXPLAINED ACTIVITY
___a. greetings
___b. name
___c. purpose

2. POSITIONED WHEELCHAIR
___a. at head of bed
___b. facing foot
___c. against bed

3. ADJUSTED WHEELCHAIR
___a. brakes
___b. jiggled chair
___c. chair safe
___d. footrests up

4. PREPARED TO ROLL PATIENT
___a. weak arm on abdomen
___b. strong arm on edge of bed
___c. own hands on hip and shoulder

5. HELPED PATIENT ROLL
___a. told patient to roll
___b. stopped roll

6. PREPARED PATIENT TO SIT UP
___a. bent knees and hips

7. HELPED PATIENT SIT UP
___a. told patient to sit and push
___b. hand under trunk
___c. pulled legs off bed
___d. supported sitting position

8. HELPED PATIENT SCOOT
___a. supported strong shoulder
___b. pulled weak hip forward.
___c. told patient to help
___d. feet flat on floor

9. READJUSTED WHEELCHAIR
___a. supported weak shoulder
___b. guided footrests carefully
___c. did not bump legs
___d. feet between footrests
___e. footrests against bed

10. PREPARED PATIENT TO STAND
___a. weak hand in lap
___b. strong hand on far armrest

11. PREPARED TO ASSIST
___a. braced strong foot
___b. knee touched patient's knee
___c. hand on trunk, strong side
___d. hand under weak hip

12. ASSISTED PATIENT TO TRANSFER
___a. told patient to stand, turn, sit
___b. helped lift hips
___c. braced knee
___d. helped turn and slowly sit
___e. bent hips and knees

13. ADJUSTED PATIENT'S FEET
___a. told patient to lower footrests
___b. told patient to place feet
___c. assisted as needed

14. ADJUSTED PATIENT'S POSITION
___a. told patient to put hands in lap
___b. arms under patient's arms
___c. grasped wrists
___d. told patient to push back
___e. lifted and pushed back

___ TOTAL ERRORS

B. Steps Out of Order (i.e., 2, 3, 1 or 10, 9)		C. Overall Quality (Excellent, Good, Fair, Poor)	

Comments (Include any negative attitude): ______________________________

Instructor: ________________ Work Address: ________________

Rancho Los Amigos Hospital, Physical Therapy Dept.
LVM:cw
August 12, 1970

APPENDIX C

INSTRUCTOR'S GUIDE FOR USE OF MOTOR ACTIVITY PROGRAMMED INSTRUCTION

INTRODUCTION

Programmed instruction is an effective tool for the teacher to use in the design of the total learning process. These motor activity programs base their effectiveness on principles of motor learning such as modeling by imitation of pictures and words, kinesthetic feeling, whole and part practice, simulation, and most important, learning by doing; and, on principles of programmed instruction such as specific measurable objectives, individual learning rate, ordered step sequence, minimal errors, and active response checked by knowledge of results. The effectiveness of the programs as a teaching tool is tested by field testing these programs, then measuring the learning that has taken place.

The purpose of the motor activity programs is to teach personnel how to do various physical therapy skills. These programs can be valuable to you as teachers because they are self-teaching units that the students can learn from without the presence of the instructor. This does not mean the programs stand alone. You will need to prepare the student to use the program, evaluate his learning, then help him transfer his learning from the "simulated patient" to the "real patient" that one encounters in the hospital. Also, you will need to discuss with the student that this is one method of doing the activity and that it will need to be modified according to different patient needs. Using one method of doing the activity with one specific type of patient is beneficial to the student with no prior learning because it does not confuse him with several possibilities before he knows one method well. However, once he has proficiency in this method he can use it as a base for learning different techniques.

The remainder of this guide is devoted to giving you suggestions for using and evaluating learning by programmed instruction. These suggestions apply to all of the programs. In addition, each program has a separate sheet of specific requirements that are unique to each program. Please use both parts to help you plan this learning process.

SUGGESTIONS FOR USING MOTOR ACTIVITY PROGRAMS

PREPARATION

To help the student gain the most from the program, you should evaluate and correct his performance as soon as possible after he completes his practice. You must, therefore, know precisely how each step and key point is taught in the program in order to evaluate successfully. Take the program yourself--read it carefully as you perform the skill. Then practice evaluating two or three people so that you will be familiar enough with the evaluation form to be able to use it easily as you observe the student.

HOW TO USE THE PROGRAM

A. Introduction

1. Capture the student's interest by explaining the purpose of the skill and its importance to good job performance.

2. Explain to the students that:

    a. They will practice the skill using the program.

    b. Their performance will then be evaluated as they perform the skill from memory.

B. Demonstration

1. If the program requires a demonstration of the skill, use a student or other person as the "patient."

2. Do the skill as the program teaches it, giving a brief verbal description as you proceed.

C. Student's Programmed Practice

1. Give one student the program. Give "Instructions to the Patient" to the student who is going to act as patient first.

2. Tell them how to use the program.

    a. Go over the introductory pages with them. (Make sure they read each page completely and understand it.)

b. Stress reading the entire page and studying the picture before doing what it directs.

c. Explain that if the students read the entire program carefully and follow the directions, this will help them do well on the evaluation.

d. Place the program on a stand or where the student can best read it and turn the pages.

e. If the student has never taken a motor activity program before, stay and observe him as he does his practice in case he does not understand how to use the program. After he has taken one or two different programs and knows how to use them you need not observe him any longer unless you want to. Always tell the student where you can be reached if he has questions during his practice, and tell him to contact you when he is ready for evaluation.

f. To facilitate learning it is important for you to evaluate the students' performances as soon as possible after their practice. If you cannot do it immediately, have them each do the skill once more without the program. This will help them remember what they have already learned. Be sure to evaluate at your earliest possible convenience.

EVALUATION

1. The evaluation form includes a checklist of all the key points to be performed by the student when performing the skill.

2. Evaluate as soon as possible after the student's practice.

3. Collect the programs.

4. Fill out all the blanks on the evaluation form.

5. Have the student do the skill from memory.

6. Place a check mark by each item omitted by the student or not done in the program. No check mark indicates that the student did that item. Each check mark counts as an error.

7. Do not show any student his mistakes before evaluating his partner.

8. Give an over-all grade (excellent, good, fair, poor) to each student according to your impression of how well he did the skill, taking into consideration factors such as coordination, patient management, safety, etc., which may not appear on the checklist.

9. After you have evaluated all the students, show each one his evaluation form, pointing out his mistakes. Have him perform correctly any steps with major errors.

Please refer to the specific program requirements for each program to find out what you will need in order to give that program.

SPECIFIC REQUIREMENTS FOR THE PIVOT TRANSFER PROGRAM

PURPOSE

The purpose of the pivot transfer is to assist a patient who can bear weight on one leg to safely transfer from the bed to a wheelchair. The method presented in this program is safe for the patient and for the one doing the transfer. It is also efficient. The specific situation selected was a patient with hemiparesis who is getting into a wheelchair for the first time.

The objective of the program is for the student who has no prior experience with the skill to perform the transfer with few or no errors in two to three minutes after completing the program.

PREREQUISITE

It is desirable, but not essential, for the student to complete the Wheelchair program before taking the Pivot Transfer program.

EQUIPMENT AND SPACE NEEDED

1. One hospital bed adjusted to a medium height with casters locked. The right side of the bed should be accessible and have sufficient space beside it to maneuver a wheelchair.

2. One pillow.

3. One wheelchair with wheel brakes and pedals that raise to the side.

PERSONNEL

1. The program is written for two students. First, one performs the transfer and the other plays the role of the patient. Then the students switch roles. If only one student needs to learn the skill, anyone can play the part of the patient and no switch in roles is required. If more than two are to learn the skill, you may wish to schedule them in pairs at different times if extra equipment and space are hard to obtain.

2. As the students watch the demonstration before doing the program, you may want two people to demonstrate the transfer as you briefly describe it or you may demonstrate it yourself.

APPENDIX D

DESCRIPTION OF MOTOR ACTIVITY PROGRAMS

GROUP I

Wheelchairs: Maneuvering and Adjusting Parts. One student learns how to lock, move, and turn a wheelchair, how to adjust footrests, how to remove and replace armrests, and how to fold a wheelchair.

Pivot Transfer. Two students learn the pivot transfer technique to help a stroke patient from bed to wheelchair.

Bridging in the Supine Position. This program teaches three students how to position a patient on pillows to relieve pressure on the sacrum.

Tilt Table: Positioning and Standing the Patient. Two students learn how to secure a patient on, and elevate the tilt table.

Range of Motion Exercises. Two students learn how to exercise passively all the joints of the arm and leg. This program is divided into three one-hour units.

Push-Up Transfer with Sliding Board. Two students learn to transfer a paraplegic patient from wheelchair to bed using a sliding board.

How to Assist a Stroke Patient into the Prone-Lying Position. Two students learn how to turn a patient onto his stomach and to position his arm.

How to do Various Crutch Gaits. The program teaches one student how to crutch walk in four-point, three-point, two-point, and swing-through gait patterns.

Mechanical Lift Transfer. The program teaches three students how to safely use a mechanical lift and how to transfer a quadriplegic patient from wheelchair to bed with the lift.

How to Adjust Canes and Crutches. Two students learn how to fit quad canes, forearm crutches, and axillary crutches to one another.

How to Assist a Stroke Patient to Walk with a Quad Cane. Two students learn how to help a patient stand, walk with a quad cane, sit in a wheelchair. They also learn how to prevent loss of balance.

GROUP II

Assisted Gait with Walker. The program teaches two students how to adjust a pick-up walker and how to safely ambulate an arthritic patient using the walker gait.

Spinal Cord Injury Assisted Gait. Two students learn one way to assist a paraplegic to lock braces, stand, walk with forearm crutches, prevent a jackknife, and sit safely in a wheelchair.

Swivel Bar Transfer. One student learns how to check the security of the apparatus, adjust the strap length, and perform the transfer from wheelchair to bed using a swivel bar.

Hip Abduction with Extension Using the Elgin Table. Two students learn how to attach the overhead cable unit to the ankle cuff, and instruct the patient to perform the exercise.

Mass Flexion Using the Elgin Table. One student learns how to assemble the boot apparatus, adjust the boot height and angle, and instruct the patient to perform mass flexion for one lower extremity.

Mass Extension Using the Elgin Table. One student learns how to assemble the boot apparatus using two boots, adjust the boot height and angle, and instruct the patient to perform mass extension using both lower extremities.

Overhead Pull with Downward Thrust Using the Exercise Board. Two students learn how to use the overhead pulley system of the exercise board to exercise the elbow extensors and shoulder girdle depressors of a lower extremity amputee.

Hip Abduction from a Guerney Using the Exercise Board. This program teaches one student how to use the exercise board to exercise the hip abductors of a patient with generalized weakness who is supine on a guerney.

Hip Extension from the Standing Bars Using the Exercise Board. This program teaches one student how to exercise the hip extensors of a hemiplegic patient who is in the standing bars.

How to Use the Rickshaw. This program teaches two students how to use the rickshaw for strengthening shoulder girdle depressors.

How to Use the N-K Table. This program teaches two students how to use the N-K table for knee extension and flexion.

How to Use the Skateboard. This program teaches two students how to use the skateboard for hip abduction and adduction, and hip and knee extension and flexion with the assistance of a skate.

How to Use Slings and Springs. Two students learn how to attach sling and spring units for the heel and thigh, and also learn how to instruct the patient in hip extension and abduction, and knee flexion exercises.

APPENDIX E

INSTITUTIONS PARTICIPATING IN FIELD TESTING

HOSPITALS AND CLINICS

Arkansas Baptist Medical Center
Physical Therapy Department
1700 West Thirteenth
Little Rock, Arkansas 72201

Charlotte Rehabilitation Hospital
Physical Therapy Department
1610 Brunswick Avenue
Charlotte, North Carolina 29203

Kaiser Hospital
Physical Therapy Department
9400 Rosecrans Avenue
Bellflower, California

Kaiser Hospital
Physical Therapy Department
12500 South Hoxie
Norwalk, California

Little Company of Mary Hospital
Physical Therapy Department
4101 Torrance Boulevard
Torrance, California 90503

New York State Rehabilitation Hospital
Department of Rehabilitation Medicine
Physical Therapy Department
West Haverstraw, New York 10993

St. Francis General Hospital
Occupational Therapy Department
45th Street
Pittsburgh, Pennsylvania 15201

Beverly Manor Convalescent Hospital
Physical Therapy Department
Seal Beach, California

El Cerrito Hospital
Physical Therapy Department
1401 Chestnut Avenue
Long Beach, California

Kaiser Hospital
Physical Therapy Department
4900 Sunset Boulevard
Los Angeles, California

LAC-USC Medical Center
Physical Therapy Department
1200 North State Street
Los Angeles, California

Long Beach Memorial Hospital
Physical Therapy Department
2801 Atlantic Avenue
Long Beach, California

Pacific State Hospital
Occupational Therapy Department
P. O. Box 100
Pomona, California

U. S. Public Health Service
New York Outpatient Clinic
Physical Therapy Department
245 West Houston Street
New York, New York 10014

PHYSICAL THERAPY ASSISTANT SCHOOLS - TWO-YEAR COLLEGES

Central Piedmont Community College
1141 Elizabeth Avenue
Charlotte, North Carolina 28204

Green River Community College
12401 S.E. 320th Street
Auburn, Washington 98002

Greenville Technical Education and
Health Careers Center
Box 5616, Station B
Greenville, South Carolina 29606

Illinois Central College
Public Junior College District No. 514
P. O. Box 2400
East Peoria, Illinois 61611

Suffolk County Community College
5333 College Road
Selden, L.I., New York 11784

PHYSICAL THERAPY SCHOOLS, COLLEGES AND UNIVERSITIES

Boston University
Sargent College of Allied Health
Professions
Division of Physical Therapy
University Road
Boston, Massachusetts 02215

Childrens Hospital
School of Physical Therapy
Box 54700
Terminal Annex
Los Angeles, California 90054

Northwestern University
Rehabilitation Institute of Chicago
Department of Physical Therapy
401 East Ohio Street
Chicago, Illinois 60611

San Fernando Valley State College
Health Science Department
Northridge, California 91324

University of Minnesota
Department of Physical Medicine
and Rehabilitation
Course in Physical Therapy
Mayo Memorial Building
Minneapolis, Minnesota 55455

University of Southern California
Physical Therapy Department
Los Angeles, California

University of Texas - Medical Branch
School of Allied Health Sciences
Occupational Therapy Department
Galveston, Texas 77550

University of Texas - Medical Branch
School of Allied Health Sciences
Department of Physical Therapy
Galveston, Texas 77550

APPENDIX F

DESCRIPTION OF SELECTED DISABILITY PROGRAMS

SELECTED ORTHOPEDIC DISABILITIES (Four units; reading time four hours)

The program includes a pre-test and post-test, each taking 20 minutes to administer. The program is designed for teaching at the level of nursing, physical therapy, or occupational therapy aides, or any learner with no prior knowledge of these orthopedic disabilities.

1. Fractures of Bones (by Cerney and McDaniel)

   The material covered in this unit includes various fracture patterns and types. It teaches how a fractured bone heals. It also describes how a doctor reduces and treats a fracture and what the physical therapy goals are, both during and after immobilization.

2. Deformities of the Spine (by McIntosh and McDaniel)

   In this unit the student learns the names of normal curves of the spine. He also learns the causes and treatment of lumbar lordosis and scoliosis.

3. Arthritis (by Cerney and McDaniel)

   This unit introduces the learner to rheumatoid arthritis, juvenile rheumatoid arthritis, and osteoarthritis. The student learns the joint pathology, the signs and symptoms, and medical and physical therapy treatment for each of these diseases.

4. Lower Extremity Amputations (by Orr and McDaniel)

   This unit contains two parts. In Part 1 the student learns four causes of loss of limb, post-surgical complications, parts of prostheses, and the difference between temporary and permanent prostheses. In Part 2 the student learns the variations of the post-surgical stump care and physical therapy goals.

SELECTED MEDICAL DISABILITIES (Four units; reading time four hours)

The program includes a pre-test and post-test covering all four units. Twenty minutes are required for administering these tests. The material is intended for the learner who has no prior experience in working with these disease entities and who needs a basic understanding of the diseases.

1. Geriatrics (by Lightfoot and McDaniel)

   This unit includes the recent medical advances for the aged, problems of aging, and advice on how to work with the geriatric patient. Also included is a section on how to recognize signs of distress during physical activity.

2. Diabetes Mellitus (by Lightfoot and McDaniel)

   This unit includes the physiology of the pancreas, causes of diabetes, and the medical treatment for this disease.

3. Tuberculosis of the Lungs (by Cerney and McDaniel)

   This unit deals with the nature and cause of the disease, the stages of the disease, the spread of infection and its prevention, and the medical treatment. There is also a section explaining the goals of physical therapy for the post-surgical lung resection.

4. Heart Disorders Caused by Coronary Atherosclerosis (by McIntosh and McDaniel)

   This unit concerns itself with three types of disorders: angina pectoris, coronary occlusion, and congestive heart failure. Disease process, systems, medical treatment, and physical therapy goals are explained for each disorder.